



Unit 1:

Greenhouse Care and Maintenance

Lesson Three: Chemical Handling

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STUDENT LEARNING OBJECTIVES:

After completing these activities students will...

1. Identify the correct personal protective equipment that must be worn while handling chemicals.
2. Examine the use of chemicals commonly used in the floriculture industry.
3. Demonstrate an understanding of proper handling, application and storage of chemicals.

TIME REQUIRED: 90 minutes

RESOURCES:

1. Shry & Reiley (2011). *Introductory Horticulture* (8th ed.). Clifton Park, NY: Delmar Cengage Learning.
2. Boodley & Newman (2009). *The Commercial Greenhouse* (3rd ed.). New York: Delmar Cengage Learning.

EQUIPMENT AND SUPPLIES NEEDED:

1. "Chemical Handling" PowerPoint
2. A copy of the "Greenhouse Safety" pre- and post-test for each student
3. A copy of the "Chemical Problem Solving" worksheet for each student
4. A copy of the "Pesticide Label" for each group or student

PREVIOUS KNOWLEDGE RECOMMENDED FOR THIS LESSON:

- Greenhouse safety

THESE ACTIVITIES ARE ALIGNED TO THE FOLLOWING STANDARDS:

AFNR Performance Element

- PS.03. Propagate, culture, and harvest plants and plant products based on current industry standards.

FFA Precept

- FFA.PL-C.Vision: Visualize the future and how to get there.
- FFA.PG-J.Mental Growth: Embrace cognitive and intellectual development relative to reasoning, thinking and coping.
- FFA-CS-M.Communication: Effectively interact with others in personal and professional settings.
- FFA.CS-N.Decision Making: Analyze a situation and execute an appropriate course of action.

Common Career Technical Core

- AG-PL3 Propagate, culture, and harvest plants and plant products based on current industry standards.

NASDCTE

- AGPB01.03 Examine and apply fundamentals of production and harvesting when producing plants to demonstrate plant management and production techniques.

Common Core- Reading: Informational Text

- CCSS.ELA-Literacy.RI.9-10.8 Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.

Common Core- Science & Technical Subjects

- CCSS.ELA-Literacy.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
- CCSS.ELA-Literacy.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Common Core- Math Practices

- CCSS.MP1: Make sense of problems and persevere in solving them.
- CCSS.MP3: Construct viable arguments and critique the reasoning of others.
- CCSS.MP6: Attend to precision.

AFNR Career Ready Practices

- CRP.02. Apply appropriate academic and technical skills. Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive.
- CRP.04. Communicate clearly, effectively, and with reason. Career-ready individuals communicate thoughts, ideas

- and action plans with clarity, whether using written, verbal and/or visual methods.
- CRP.05. Consider the environmental, social and economic impact of decisions. Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organizations and the environment.
- CRP.08. Utilize critical thinking to make sense of problems and persevere in solving them. Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem.

Partnership for 21st Century Skills

- Communication
- Environmental Literacy
- Information Literacy
- Productivity and Accountability

LESSON PLAN:

1. *Introduction* (suggested time 15 minutes) **Refer to slides 1 and 2 of the “Chemical Handling” PowerPoint to present the lesson objectives and the “Greenhouse Safety” pretest.**

Chemicals are a large component of daily life in the greenhouse industry. Before you can work with chemicals, you need to understand basic safety procedures to ensure safety for yourself, your co-workers and the environment. To begin the lesson, let's take a moment to see what we already know about basic greenhouse safety.

Have students complete the Greenhouse Safety pretest. Remind them that this is to see what they already know, and if they do not know something, they should take an educated guess. Once students have completed the test, collect them.

How do you think you did? What questions did you find easy? What question were you unsure of? As we go through this lesson, we will discuss the different things mentioned in the test as we get more in-depth on personal protective equipment (PPE), fertilizers and pesticides. After the lesson, you will get a chance to take the test again.

2. *Lecture* (suggested 10-15 minutes per section) **Refer to slides 3-33 of the “Chemical Handling” PowerPoint to present information on PPE, fertilizers and pesticides.**

This lesson covers personal protective equipment (PPE), fertilizer and pesticide items found on the “Floriculture Equipment and Supply Identification List.” These items divide the lesson into three sections. In addition to identifying these items, the PowerPoint includes further explanation into handling and applying chemicals as well as reading labels. These are explained to help prepare students for the annual “Problem Solving/Decision Making Activity” and the rotational “Handling a Hazardous Situation Practicum.” More information on these events and their rubrics can be found in the [Floriculture Handbook](#).

Refer to slides 3-13 to discuss personal protection equipment.

PPE is anything that helps protect you when you are working. Depending on the job you are completing, PPE can be wearing a hard hat at a construction site or a respirator working in a silo. Whatever unique hazards accompany an industry, there is PPE required to protect the health and safety of the individual and should be put on before entering the workplace. Listed here we see the PPE required in the greenhouse industry.

Refer to slides 14-19 to discuss the questions for the fertilizer activity.

At the completion of the fertilizer section, give students a copy of the “Chemical Problem Solving” worksheet and “Pesticide Label” PDF and have them work on scenario one and two. You can have them do this individually, in groups or as a class. These scenarios were derived from the “2015 Problem Solving/Decision Making Activity” in the floriculture CDE.

Refer to slides 20-32 to discuss the questions for the pesticide activity.

At the completion of the pesticide section, have students turn back to the “Chemical Problem Solving” worksheet and “Pesticide Label” PDF and have them work on scenario three. Again, you can have them do this individually, in groups or as a class. These scenarios were derived from the “2015 Problem Solving/Decision Making Activity” in the floriculture CDE.

3. *Reflection* (suggested time 15 minutes) **Refer to slide 34 of the “Chemical Handling” PowerPoint to begin the “Greenhouse Safety” post-test assessment.**

Now that we have had a chance to discuss proper PPE and proper handling of fertilizer and pesticides, let's take that test again, so we can see what new information we gathered and how much we retained from this lesson.

Have students complete the Greenhouse Safety post-test. Remind them that these are the same questions from the first test and it's over the material covered in this lesson. Once students have completed the test, go over it as a class and discuss their progress.

Do you feel you did better on the test this time? What are some questions you didn't know before that you know now?

Students can turn this in for a daily grade and/or a formative assessment. Be sure to check that they have the right answers down for the post-test. If students are missing answers, review those items before moving on to the next lesson.

4. **Leveling Up:** For students who finish early or want to practice the identification activity in the Floriculture CDE.
 - a. If you have internet access, have students use the identification cards on the [National FFA Quizlet](#) page to practice identifying items discussed in class.
 - b. If you do not have internet access, create a set of flash cards using the slides of this PowerPoint, so students can practice identifying items discussed in class.

NAME: _____

Greenhouse Safety

Pre- and Post -Test

DIRECTIONS:

Identify if this is the "pre" or "post" version of this test by circling the word in the title above.
Answer the following multiple choice and true/false questions by circling the correct answer.

1. When does personal protective equipment (PPE) need to be put on?
 - a. When you start the job
 - b. 5 minutes after the job has begun
 - c. Before you enter the workplace
 - d. Before the supervisor walks in
2. What shoes are appropriate to wear in a greenhouse?
 - a. Steel-toed boots
 - b. Rubber boots
 - c. Flip-flops
 - d. All of the above
 - e. A and B
3. If a label has the signal word "Warning," what toxicity level is it?
 - a. Toxicity I
 - b. Toxicity II
 - c. Toxicity III
 - d. Toxicity IV
4. What is the appropriate amount of time required for re-entry if a chemical is Toxicity I?
 - a. Immediately
 - b. 24 hours
 - c. 48 hours
 - d. As soon as the dust/mist settles

5. What is the appropriate amount of time required for re-entry if a chemical is Toxicity III?

- a. Immediately
- b. 24 hours
- c. 48 hours
- d. As soon as the dust/mist settles

6. If you are using a fogger pesticide, what kind of PPE is required?

- a. Chemical resistant gloves
- b. Spray suit
- c. Respirator or gas mask
- d. All of the above
- e. Only B and C

7. Fertilizers and pesticides can be stored near food and animals.

True

False

8. Some states allow disposing of a chemical container in a sanitary landfill.

True

False

9. If a container is damaged, the chemical cannot be put in a new container.

True

False

10. It is a violation of federal law to use a pesticide in a manner that is inconsistent with its labeling.

True

False

KEY Greenhouse Safety Test

1. When does person protective equipment (PPE) need to be put on?
 - a. When you start the job
 - b. 5 minutes after the job has begun
 - c. Before you enter the workplace**
 - d. Before the supervisor walks in
2. What shoes are appropriate to wear in a greenhouse?
 - a. Steel-toed boots
 - b. Rubber boots
 - c. Flip-flops
 - d. All of the above
 - e. A and B**
3. If a label has the signal word "Warning," what toxicity level is it?
 - a. Toxicity I
 - b. Toxicity II**
 - c. Toxicity III
 - d. Toxicity IV
4. What is the appropriate amount of time required for re-entry if a chemical is Toxicity I?
 - a. Immediately
 - b. 24 hours
 - c. 48 hours**
 - d. As soon as the dust/mist settles
5. What is the appropriate amount of time required for re-entry if a chemical is Toxicity III?
 - a. Immediately
 - b. 24 hours
 - c. 48 hours
 - d. As soon as the dust/mist settles**
6. If you are using a fogger pesticide, what kind of PPE is required?
 - a. Chemical resistant gloves
 - b. Spray suit
 - c. Respirator or gas mask
 - d. All of the above**
 - e. C and D
7. Fertilizers and pesticides can be stored near food and animals.
True
False
8. Some states allow disposing of a chemical container in a sanitary landfill.
True
False
9. If a container is damaged, the chemical cannot be put in a new container.
True
False
10. It is a violation of federal law to use a pesticide in a manner that is inconsistent with its labeling.
True
False

Aligned to the following standards:
PS.03; FFA.PL-C; FFA.PG-J; FFA.CS-M; FFA.CS.N; AG-PL3; AGPB01.03; CCSS.RI.9-10.8;
CCSS.RST.9-10.4; RST.9.10.7; MP1; MP3; MP6; CPR.02; CPR.04; CPR.05; CPR.08

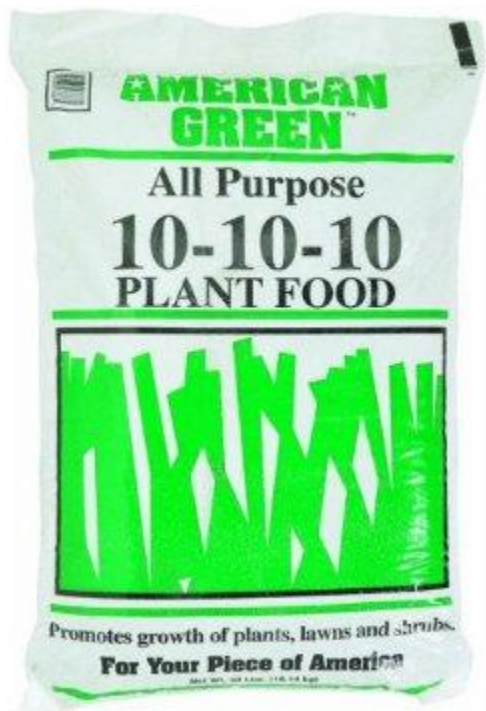
Chemical Problem Solving

DIRECTIONS:

Use the information learned during the lesson, the details provided in the scenarios and the pesticide label to answer the questions related to chemical handling in the greenhouse.

Scenario 1

Your supervisor told you to buy nitrogen fertilizer for the greenhouse, so you bought a 30 pound bag of All Purpose Fertilizer from the gardening store. The fertilizer grade listed on the bag is 10-10-10, and you intend to use it when your shipment of plug trays come in next week. Before you can use it, your supervisor questions you about your purchase, wanting to know how much of this fertilizer is actually nitrogen and how it needs to be applied. Answer his questions below.



http://ecx.images-amazon.com/images/I/51u10AoTwfL_SY355_.jpg

1. How will the All Purpose Fertilizer be applied?
2. How many pounds of nitrogen are in the 30 pound bag?
3. What is the total weight (in pounds) of nitrogen, phosphorous and potassium?

Scenario 2

You have been promoted at the greenhouse. One of your new responsibilities is to mix the water-soluble fertilizer in the 55-gallon tank. This tank is associated with a fertilizer injector and provides fertilizer for the greenhouse when plants are watered daily. You are told to mix nitrogen at a 1:100 dilution ratio at 325 parts per million (ppm). No one told you how much to mix to make the right solution, but you find the following table posted on the wall:

Dilution Rate	Parts Per Million Nitrogen						
	25	50	75	100	200	300	400
	Ounces Per Gallon						
1:200	3.33	6.43	9.65	12.85	25.70	38.60	51.40
1:100	1.61	3.22	4.82	6.43	12.85	19.27	25.70
1:15	.25	.50	.75	1.00	2.00	3.00	4.00

1. Using the table, how many pounds of fertilizer will go into the 55-gallon tank?

2. How is this application different from scenario 1?

Aligned to the following standards:

PS.03; FFA.PL-C; FFA.PG-J; FFA.CS-M; FFA.CS.N; AG-PL3; AGPB01.03; CCSS.RI.9-10.8; CCSS.RST.9-10.4; RST.9.10.7; MP1; MP3; MP6; CPR.02; CPR.04; CPR.05; CPR.08

Scenario 3

Aligned to the following standards:
PS.03; FFA.PL-C; FFA.PG-J; FFA.CS-M; FFA.CS.N; AG-PL3; AGPB01.03; CCSS.RI.9-10.8;
CCSS.RST.9-10.4; RST.9.10.7; MP1; MP3; MP6; CPR.02; CPR.04; CPR.05; CPR.08

You have been hired to spray pesticide at a local chapter greenhouse. Your co-worker suggested you use Mavrik Aquaflo, and they give you the label to look over. Read over the pesticide label and answer the following questions.

1. What kind of PPE needs to be worn when applying this pesticide?
2. How should this pesticide be stored?
3. What must you do before you recycle or burn this container?
4. Will the pesticide treat whiteflies inside a greenhouse?
5. How many tablespoons need to be mixed with a 25-gallon sprayer at a high rate?

KEY Chemical Problem Solving

SCENARIO 1

1. How will the All Purpose Fertilizer be applied? **Dry application mixed into soil before potting**
2. How many pounds of nitrogen are in the 30 pound bag? **3lbs. of nitrogen $30\text{lbs} \times .10 \text{ N} = 3\text{lbs. of N}$**
3. What is the total weight (in pounds) of nitrogen, phosphorous and potassium?
9lbs. of active ingredients (NPK) $3\text{lbs of N} + 3\text{lbs of P} + 3\text{lbs of K} = 9\text{lbs NPK}$

SCENARIO 2

1. How is this application different from scenario 1? **This is a water-soluble fertilizer and requires liquid application. Fertilizer is mixed into the irrigation system and applied during watering, a process called fertigation.**
2. Using the table, how many pounds of fertilizer will go into the 55-gallon tank? **71.75 lbs.**

Set up a ratio equation (practical algebra) using numbers in the chart

$$\frac{19.27}{300} = \frac{X \text{ (oz. per gallon)}}{325}$$

$$300X = 6262.75$$

$$X \text{ (oz. per gallon at 325 rate)} = 20.88$$

$$20.88 \times 55 \text{ gallons} = 1148 \text{ ounces}$$

$$1148 \text{ oz. divided by 16 oz. to a pound} = 71.75 \text{ lbs.}$$

SCENARIO 3

1. What kind of PPE needs to be worn when applying this pesticide? **Chemical resistant gloves, respirator, long shirt and pants and proper footwear.**
2. How should this pesticide be stored? **Cool, dry place away from children, other products, food or feed.**
3. What must you do before you recycle or burn this container? **Triple rinse the container by filling it up one-fourth of the way, capping it, shaking it and draining it three times.**
4. Will the pesticide treat whiteflies inside a greenhouse? **Yes.**
5. How many tablespoons need to be mixed with a 25-gallon sprayer at a high rate? **5 tablespoons**

Under the greenhouse control section it lists two ways to calculate for high rate: .5 ounces per 5 gallons of water or 3 teaspoons per 5 gallons of water.

The problem called for a 25-gallon sprayer:

$$5 \times .5 \text{ oz. per 5 gallons} = 2.5 \text{ ounces}$$

$$5 \times 3 \text{ tablespoons per 5 gallons} = 15 \text{ teaspoons}$$

$$\text{*convert to tablespoons* } 1 \text{ ounce} = 2 \text{ tablespoons, } 3 \text{ teaspoons} = 1 \text{ tablespoon}$$

$$2.5 \text{ ounces} = 5 \text{ tablespoons and } 15 \text{ teaspoons} = 5 \text{ tablespoons}$$